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Mushroom News

A QUARTERLY JOURNAL FOR MUSHROOM GROWERS

Vol. VIII No. 4 APRIL 1961

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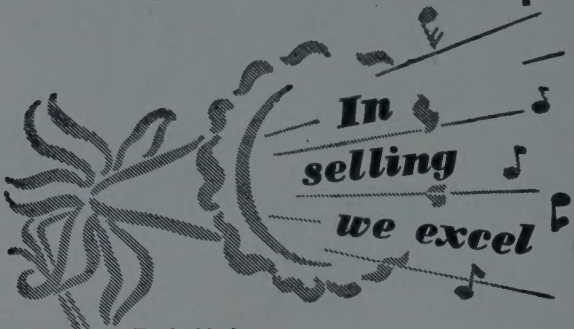

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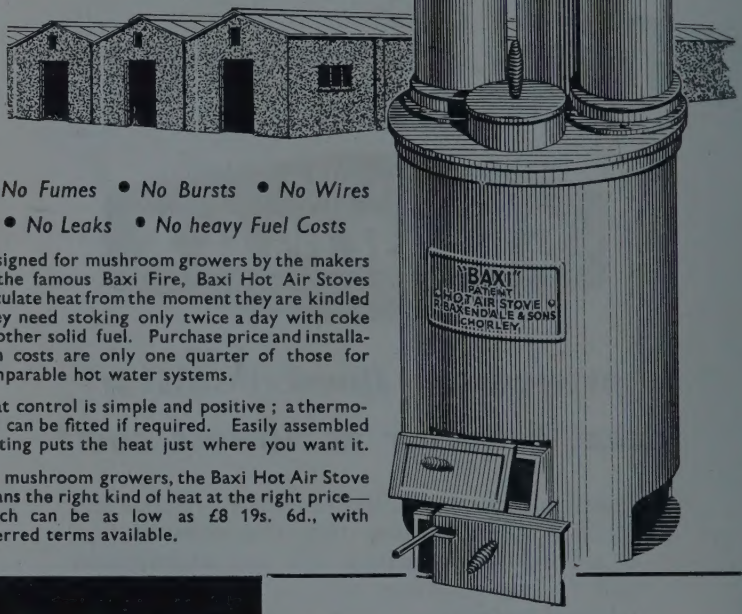

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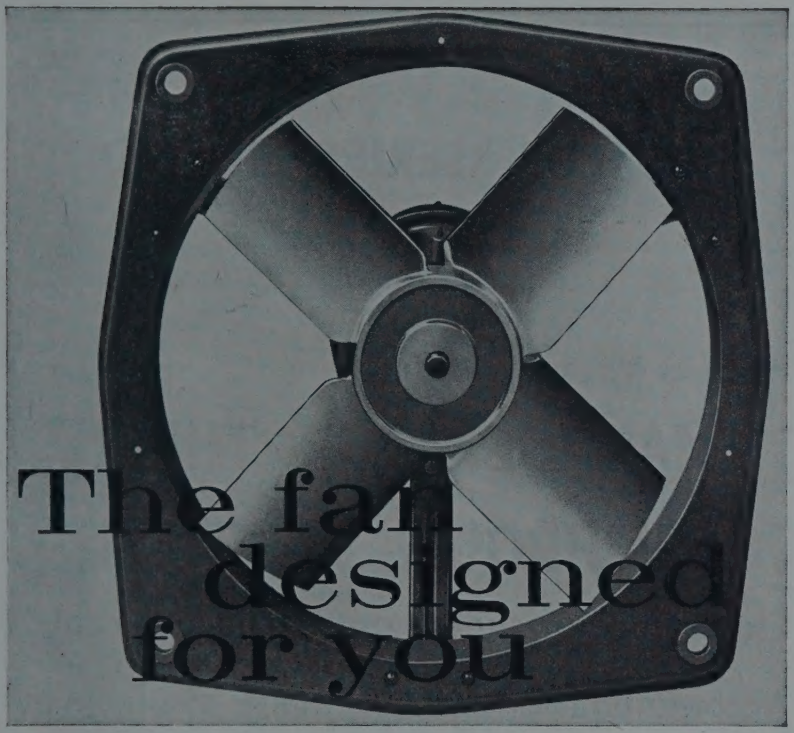

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Mushroom News

Vol VIII No. 4 APRIL 1961

CONTENTS

EDITORIAL: 61

NOTES AND NEWS: 62

THE CASING LAYER: 64

MODERN MUSHROOM EQUIPMENT—
The "Linfield" Manure Turner: 70

SPENT MUSHROOM COMPOST—
H. G. Schaffer: 75

NEW BOOKS—
Mushrooms and Truffles by Rolfe Singer, Ph.D. 76

A.G.M.—M.G.A.
John Brody 78

QUESTION BOX 80

OUR FRONT COVER

The Nitrogen level of composts is the vogue in mushroom growing to-day. Our front cover shows a corner of the Analytical Department of Darlington's new laboratories at Worthing. They are fully equipped with the latest digestion and distillation apparatus for rapid and accurate Nitrogen determination by the Kjeldahl method.

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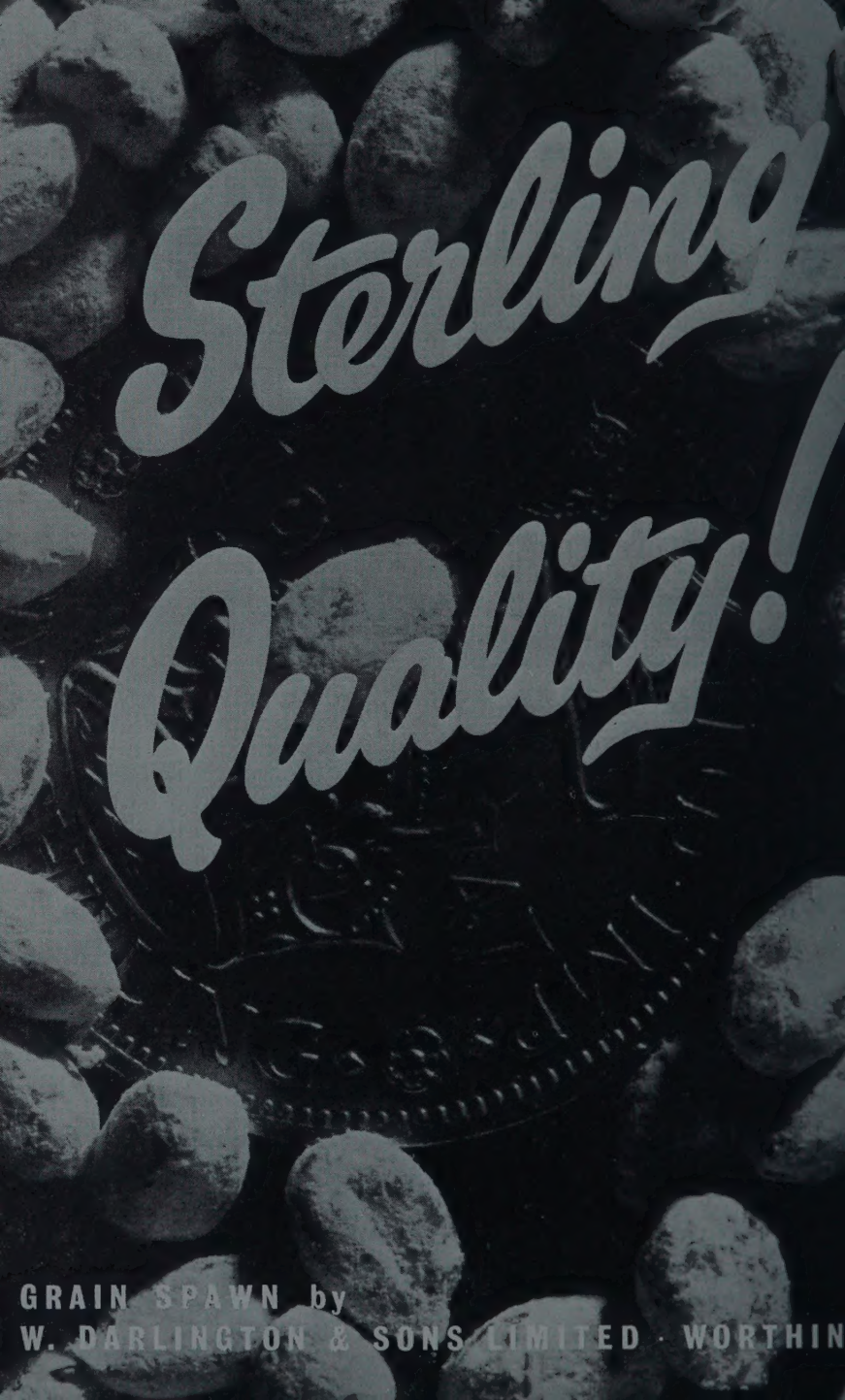
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Mushroom News

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WORTHING ENGLAND

Vol. VIII No. 4 **APRIL 1961**

We often wonder how much of the money put into obtaining fine crops of mushrooms on the beds is wasted subsequently because the marketing of the produce is mishandled. To some growers yield per square foot has become the be-all and end-all of growing. It is almost as though they regard the pickers as vandals, come to destroy what they have created, and they cannot bring themselves to take any interest in the mushroom once its connection with the bed has been severed!

Most growers have adopted a fatalistic attitude towards prices. They are good or bad, they are influenced by the cropping of the big producers, by seasonal gluts and the weather. They vary from market to market and there is only one constant factor—that they show a steady decline in relation to costs.

Now this is true of prices in general, but it need not necessarily be true of any particular grower's prices. Average price follows a pattern certainly, but it is not the price actually paid. Some growers get more than average, some get less, and it is not luck or influence that leads to a grower consistently obtaining more than average price. It is because buyers know that his mushrooms are good, and as a result a demand is created; depending upon how good his mushrooms are, and the resulting demand and his ability to fill it, is the premium he can expect over the average price.

Bad marketing starts right from the time of picking; is the mushroom tossed into a basket, or is it placed carefully in position? Is it cleaned, or sent to the packing room with its quota of dirt? Grading to a high standard is essential if the grower is after premium prices, and the standard must be consistent. Buyers will not pay more than average prices unless experience has told them on repeated occasions that the contents of a chip basket are worth it *right down to the last mushroom.* Buyers do not have time to examine each chip individually; they look for a mark or name they can trust. Once they find it, they are prepared to order by telephone and without sample because they know they will get just what they are ordering. Such a feeling of trust can be worth a great deal of money to a grower, but he will establish such a relationship with the market only after he has proved that his standards are high and that he maintains them.

Accurate and consistent grading goes a long way towards premium prices, but it is backed up by good presentation. Faced by the choice

from two samples of roughly equal quality, most buyers will choose the one that looks the best. Poor presentation of even top grade mushrooms will reflect in their price.

Mushrooms should look clean; obvious? Not at all! It is surprising how many dirty mushrooms go to market, when a flick or two of a brush will remove the dirt. It takes a second or two longer, but it pays dividends when combined with other factors of presentation. Chips should be lined with a good blue paper to set off the quality of well graded mushrooms. If the grower wants a good price he must use a good chip basket that will protect the contents from damage in transit and show them off to advantage in the shop display. There are many qualities of container from inferior cardboard to good white veneer and we have discovered that the grower who is most clamorous about the quality of his chips is also the one obtaining the best prices.

We would like to ask growers: when was the last time *you* went to the wholesale market? No doubt the salesmen's representatives call regularly on the farm, but that is not the same. The salesman is the grower's agent, his link with the purchaser, the man who knows more about selling mushrooms than most people. He knows what is required to get the best prices. Try and obtain from him an honest opinion of your wares. It may be difficult but if you convince him that you want the truth and will not be hurt by it, you may get a frank and honest appraisal of your packing and marketing efforts. It can do you nothing but good.

Notes and News

Fewer Tomatoes.

The acreage of heated glass put down to tomatoes fell by some 9½% last season, and reliable sources claim that this season the decline will be much greater. It is believed that many small men with limited glass are leaving the industry, and that the actual loss of growers to horticulture is much greater than the figures for acreage reveal.

Agariphobes?

For those interested in market research, we pass on a piece of apparently useless information gleaned from Granada Television. Chimpanzees hate mushrooms! In a new series "The Animal Story" it was demonstrated that they broke mushrooms up into small pieces and swept them out of sight.

For those who think Freud might have something to do with it, we learned that it is not the shape but the smell that they abominate. A banana smeared with mushroom scent had to be thoroughly cleaned before they would peel it.

Can it be that love of mushrooms goes with advanced cultural development? Certainly the quickest way of measuring the standard of living of a country is to take a look at its mushroom industry. The more developed the industry, the higher the standard.

Little Improvement

Rather surprisingly, only 2,000 applications for grants have been made during the first year of the Horticultural Improvements Scheme. When the scheme was introduced it was estimated that the number of

growers who might benefit was around 35,000.

The fact that the growers must find two thirds of the amount required for the improvement may be a deterrent in some cases, but the prospect of a free gift of the other third—without strings!—should be sufficiently attractive to make ambitious growers review their resources of capital and credit.

The Horticultural Improvements Scheme was hailed with wide publicity, and the prospect of some seven and a half million pounds being made available for distribution to the industry seemed at the time to be a much needed shot in the arm. The lack of response once the initial excitement was over is, perhaps, symptomatic of the degree of apathy that pervades horticulture.

Mr. Butler Warns

Mr. R. A. Butler, the Home Secretary gave a blunt warning to commercial horticulture when he addressed Essex fruit growers at a Chelmsford reception of Associated Fruit Growers of Essex Ltd.

"I know of no person in the country at the moment who could give any accurate answer as to what will happen in Europe, so far as horticulture and free trade are concerned," he said.

"It is an unfortunate fact that horticulture is a most vulnerable industry in negotiations with Europe. At the moment the Government has no plan and it would be impossible to have a real plan in present circumstances."

He went on to point out that one of the major factors was the continued rise in the production of apples in Western Europe. The real problem was not imports alone, but finding markets for an increasingly heavy home crop. More emphasis must be placed on better marketing and increased demand and it was remarkable that in a country that produced the finest apples in the world, consumption averaged only ½-lb. per head per week.

Short Course

The Mushroom Industry Short Course will again be held at the Pennsylvania State University from the 19th to the 21st June this year. As usual lectures and field work will cover all aspects of mushroom growing from manure to merchandising.

There will be no Short Course in 1962 because it is planned that year to hold the International Mushroom Congress at Philadelphia. Growers will recall that the last International Congress was held in Copenhagen in 1959.

Also Present

In a paper on pest control in mushroom growing, Mr. Paul Dekeirel mentions that the fauna of a mushroom house includes 115 species of insects, 8 species of mites, 2 species of eelworm. Luckily for growers, relatively few of the species are parasitic on mushrooms.

Watery Stipe crosses Atlantic

American mushroom growers are being attacked by the complex of troubles that are known here as Watery Stipe Disease or Brown Disease and sometimes specifically as "La France". Serious outbreaks of trouble in the Kennett Square area, the heart of the American mushroom industry, are reported.

Danish Experiments.

A report from Denmark informs us that recent experiments show maximum yields are obtained on 20 to 30lb. of compost per square foot of bed. This, we are told approximates to a depth of compost of one foot in the trays or on shelves.

" It will by now be appreciated that the casing layer plays a very important part in mushroom growing, for it appears to influence the formation of pinheads and so control cropping."

THE CASING LAYER

The casing layer is believed to hold the secret of successful cropping, but while it has held the attention of many research workers over years, there is still no complete answer as to its function. In this article we offer practical advice to the grower on the selection and use of his casing materials in the light of practical experience backed by experimental trials.

THERE are considerable differences of opinion as to why a mushroom compost needs a casing layer if it is to give an economic yield of mushrooms. Compost will crop without casing, but the mushrooms will be so few and far between that it could hardly be said to crop at all. Yet add an inch or two of another material and, with correct management, the mushroom potential of the compost can be fully developed.

Why then is it necessary to seal, cap or case the compost with this layer? There are two purely mechanical reasons which can hardly be disputed. Mushrooms that form on the surface of the compost have little support from their roots. They would tend to fall over and be easily damaged in the absence of some material such as the casing layer which evens out the surface of the bed or tray and provides foundations for the mushroom or cluster of mushrooms.

Secondly the compost would dry out rapidly if it were exposed to the atmosphere and although not impossible, it is exceedingly difficult to remoisten the compost without killing or badly damaging the mycelium. Consequently the casing layer acts as a cap to the compost, preventing the evaporation of the essential moisture content of the compost.

These two reasons apart, what other purpose has the casing layer? Over the last ten years, a period of intense activity in casing layer research, a number of theories have been put forward and debated with heat. It is probable that the ultimate answer contains elements from all these theories, and that there is no straightforward reason why casing is necessary.

It was held at one time that the casing layer, containing as it does, no food materials, offered a contrast to the compost. The mycelium grew out into this zone of starvation and was induced to fruit in order to perpetuate its species. But Dr. Leon Kneebone, speaking at Bournemouth in October 1958, told of experiments that showed that beds cased with pasteurised compost which had been dried and ground and re-moistened yielded 1½-lb. per square foot off three inches of fill. A replicate trial using pure sand presumably completely devoid of nutriment also gave a normal yield. This would seem to show that the actual material of the casing layer is not important provided its physical

Peat and chalk casing material heaped on the open-stacked trays before spreading to an even depth of 1½ inches.

properties fulfil certain basic essentials, but E. B. Lambert showed that where a casing layer contained a high magnesium content, yield was depressed, and one therefore assumes that there must be some uptake by the mycelium from the casing layer.

Allied to this theory of starvation is that of shock treatment. Most plants tend to produce fruits or flowers if a period of shock treatment is given during growth. Many nurserymen know of the standard practice of stripping off bean leaves to help to set the flowers, the shock inducing them to fruit. In the same way, it is postulated that pinheads can be induced to form if the temperature is dropped and a fairly heavy watering is given. The casing layer must form an essential buffer state in this shock treatment.

More recent research into casing materials has followed two lines. In England, P. B. Flegg at the Glasshouse Crops Research Institute at Littlehampton has been investigating the salts present in the casing layer and their influence on fruiting. Another promising line mentioned by Dr. Kneebone investigates the 'growth substances' produced by the mycelium. These 'growth substances' can be gaseous in nature and affect the formation of fruiting bodies, and it is held that the casing layer provides a medium in which they can accumulate until they reach a certain critical concentration. Pinheads are then formed, which, of course develop into the fruiting bodies or mushrooms. If these 'growth substances' diffuse away too freely (as would occur if there was no casing layer) pinheads would not form. If the casing layer is in such a condition that too much accumulates, then they may have the opposite effect and inhibit growth.

McTeague, Hutchinson and Reed* carried out experiments in 1959 on mushroom mycelium and eventually isolated a chemical substance that was given off by the growing spawn. This chemical was tentatively identified as 2:3—dimethyl-l-pentane and it seems highly probable that this substance is responsible, either solely or partly, for the phenomenon of 'pipping up'.

It will by now be appreciated that the casing layer plays a very important part in mushroom growing, for it appears to influence the formation of pinheads and so controls cropping. Nevertheless relatively little is known about the essential properties of a good casing material, and the mixtures arrived at today and used by growers are the result of practical trial and error.

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* *Nature*, 183, *p.* 1736 (1959).

Measuring out the casing mixture by a special scoop that ensures that the exact amount is placed on each tray to cover it correctly.

Until 1955 the majority of mushroom growers cased with soil, and there were many mixtures in use. To improve the structure of the soil ashes were mixed in, and already a number of growers were using peat, both with clayey soils to give a better crumb structure, and with sandy soils to aid moisture retention.

However, the supply of casing soil, particularly in the West Sussex area, at that time the centre of mushroom growing, began to show signs of drying up. With so many mushroom farms crammed into a small area, the risks of using contaminated soil increased, and the sterilisation of all casing materials looked as though it would become standard practice.

At this time the Mushroom Research Association were carrying out an investigation into casing materials at Yaxley, and for research purposes they were using, amongst other materials, peat, chalk, sand and vermiculite. It was not long before word was carried to the south that peat was a possible alternative to soil, and soon growers were carrying out their own trials to find the best mixture.

There can be no doubt that peat has three great advantages over soil. It is very much easier to handle for it is so much lighter than soil, and provided certain precautions are taken, it is clean and need not be sterilised. Peat also has a standard physical structure and generally speaking while a grower obtains his supplies from one source he will obtain a standard product that varies only within definite limits. However, by itself it is too light and contains too much air so that its moisture-retaining potential is reduced. It is therefore necessary to add something to the peat that will give it 'body', that will itself hold water, and that is at least as uncontaminated as peat.

While growers were carrying out initial trials with alternative casing materials, some found that lump chalk, by itself or mixed with other materials, gave satisfactory results. Soon various mixtures of peat and chalk, and peat and limestone chippings were being tried and found to be workable. This was a most advantageous combination for peat is acid in reaction and requires neutralising. The presence of a certain amount of chalk dust in the mixture effects this neutralisation and no additional lime is required.

There are a variety of peats available on the market, and when purchasing the grower must bear a number of factors in mind of which the price is an important one, but not necessarily the most important. The majority of growers today use a

moss peat in preference to a sphagnum peat, and they usually purchase it baled rather than loose. When considering sources of supply of baled moss peat it is worth considering the consistency of granulation. No two peats require exactly the same management, and each demands certain conditions if the best crop is to be obtained. If the quality of the peat varies almost from load to load it will be difficult to adjust crop management to ensure best results. Consistency of quality ties in with availability of supplies; obviously it is no good mastering the management of peat from one particular bog only to find that supplies suddenly start coming from somewhere else. Moisture content is vitally important where peat is bought by weight, but it also affects handling problems for those growers who buy by the bale. A bale weighing on average 1½-cwt. can double this weight when damp, and will throw extra strain on men and machines.

Growers have individual preferences where the mixture is concerned, and there are variations from two parts of chalk to one of peat, to equal parts of chalk and peat. The chalk itself should not be too fine; a common mistake is the use of a ground chalk that is no more than a powder. This powder permeates the peat, forming it into a solid mass with little or no crumb structure, and consequently very little evaporation. The casing layer will settle down into a waterlogged mass preventing all diffusion of carbon dioxide from the beds and perhaps affecting the accumulation of the 'growth substances' we have referred to above. The best chalk for general purposes will pass through a ⅝ inch screen, and will have practically no dust at all. This particular quality is sometimes known as Kibbled chalk. It is also advisable to add to each hundredweight of peat four pounds of superphosphate of lime and three pounds of gypsum. It has been our experience that the crushed chalk obtained is not always completely free from quicklime, and when this is mixed with the wet peat there is rapid heating up, a process that can affect the structure of the peat. By adding superphosphate and gypsum the quicklime is neutralised.

Surprisingly enough, wetting peat can be one of the most difficult of operations. Damp peat readily takes up water, but when peat is dry it becomes water-repellent. A common method on larger farms is to immerse the bale of peat in a tank of water. After the peat is completely saturated, excess water is drained away through an escape pipe at the bottom of the tank.

A well designed casing shed. Note the openings in the wall through which the chalk can be unloaded.

The interior of the casing shed. Note the bins, in which the peat is broken down and immersed in water before mixing with chalk

The actual depth of the casing layer varies considerably; with soil it used to be one inch, and nowadays with peat/chalk mixtures it is usually 1½ inches. Many growers who complain of patchy cropping claim that their beds are cased to this depth, yet on examination it is frequently found that due to the uneven surface of the compost, casing varies from ¼ inch to 3 inches in thickness, although presenting a neat level finish to the tray or bed! One of the biggest advantages of mechanical casing is that it ensures an absolutely even layer of casing over all the trays that pass through the machine.

As a general cultural rule the surface of the peat should tend to be slightly drier than the underlying layers of peat as a result of the general air movement in the house. While some modern growers prefer to encourage deliberately a degree of overlay and then control it by careful watering and humidity control, less experienced growers might find that the overlay has developed to such an advanced stage that it is difficult to control and subsequent mushroom production would be delayed or reduced.

Many growers go to the other extreme, ensuring that the top ½ inch of peat is kept almost bone dry so that as the spawn grows up into it, it meets decreasing moisture and tends to give a larger and heavier type of mushroom. To achieve this drying it is usually necessary to run the fans immediately the beds have been cased rather than to wait until the spawn has grown into the casing before ventilation is given.

It is doubtful whether this method provides maximum yields, particularly with a relatively short cropping period. Certainly it tends to encourage particles of casing to adhere to the caps of the mushrooms, making them look 'dirty' and reducing their sales appeal.

An alternative method sometimes practised is to case the beds or trays in the usual way with an inch layer of moist peat and chalk and as soon as the spawn has started to grow into this layer, to add a further 1 inch of peat casing consisting of dry peat and chalk. When the beds are watered with the top ½ inch of the peat dried out, this surface layer allows the moisture to penetrate through into the lower moisture layers of the peat. In this way a top drier layer of casing is maintained. Many growers keep the top layer of casing in an 'open' condition by disturbing it regularly when picking takes place. In this way gases are released, and stroma formation is prevented, but there is no doubt

that cropping can be slowed down by this treatment and perhaps overall yield reduced unless a long cropping period is envisaged.

While peat casing is usually blamed for any diseases or pests that strike the crop this is usually an unfair accusation and one that is rarely borne out in fact. A bale of Irish or Dutch peat, when it arrives on the mushroom farm, well wrapped in hessian or burlap is usually free from any infection likely to affect the crop. But whether that peat is still free from infection when it is spread over the compost is another matter, and one that depends very largely on the individual mushroom farm.

Often the bales are unloaded on to a piece of waste ground, saturated with water and probably alive with eelworms and disease spores. Due to an oversight some of the bales are left for several weeks until the hessian has rotted and the peat has spilled out. The chalk arrives in a tipper and is unloaded on to a concrete standing, adjacent perhaps to the composting yard or a stack of empty trays. Spent compost is removed past both peat and chalk. Mixing takes place in a shed that is used for other purposes; it has been seen on occasions to take place in the open air close to the site where spent compost was being emptied from trays into waiting lorries.

It is important to realise that in almost all cases both the peat and the chalk arrive at their farms free from infection. Nevertheless, such is the nature of peat, such the conditions of mixing, transporting and spreading, that the casing will easily become infected with pests or diseases unless precautions are taken.

It is best to allocate one building as a casing shed, and to use this shed for nothing but casing materials. There should be suitable bins within the shed for wetting the peat, and adequate space for mixing it with the chalk. Workers concerned with mixing and casing should wear at the least, special rubber boots which are decontaminated after use, and if possible, special overalls reserved for that job alone. In this way they will not bring contamination into the casing shed from other parts of the farm.

When supplies of peat and chalk are delivered, it is advisable to arrange days when emptying is not in progress. The bales of peat should be unloaded from the lorry or van directly into the shed through large openings in the wall—openings which can be closed with wooden shutters. In this way there is no tramping into and out of the shed, with consequent risk of infection being carried in from outside.

It may be necessary to carry a stock of peat and in this case it is important to see that there is concrete underneath which has been well washed down and treated with a good disinfectant such as S.D.N.O.C. If possible the peat should be under cover in a closed building, and full sanitary precautions taken, but if this is not possible the reserve stack of baled peat should be as far away from the centre of activities as possible. It is important to stack the peat in such a way as to ensure a regular turnover of the stack; otherwise some bales will remain at the bottom or back of the stack, gradually deteriorating until, when needed, they have virtually disintegrated!

MODERN MUSHROOM EQUIPMENT

THE 'LINFIELD MANURE

The Linfield Manure Turner in use on our Experimental Farm has been a focus for the attention of visiting growers, representing as it does a high peak in mushroom farm mechanisation. In this article we set out the details of the machine and and its method of operation, and go on to discuss some of the economic factors involved so that growers can consider whether it might not be worth their while to invest in one.

Perhaps one of the most startling advances in mushroom cultivation during the last ten years has been that in the field of mechanical composting. Ten years ago there were barely a dozen manure turners in use and even then the largest farms relied to a great extent on hand labour to turn their compost.

Today most mushroom farms of more than a few thousand square feet rely on the services of a manure turner and would be in difficulties without it. The early, simple models consisting of an elevator and some form of rotating drum have been developed to reach new levels of efficiency and reliability, and for those growers who are large enough there is the Linfield Turner.

Some eight years ago Linfields were exploring the possibility of a further mechanisation of their rapid composting process. They had in mind the use of some sort of conventional turner, feeding it by means of a hydraulic grab. They contacted a firm of Scottish engineers, Cuthbertsons, regarding the grab, and when they explained the problem they were tackling, it was suggested that some form of fully automatic turner was a feasible idea. Throughout 1954 the design of the machine was argued stage by stage, and by 1955 the first model was delivered and went into use.

Naturally there were a number of snags that came to light only under the intense pressure of practical use. A second model, incorporating many modifications, was in use when growers visited Chesswood Nurseries at an Open Day in July 1956. Subsequently more improved machines were purchased and interest in the turner spread to other farms. Tribute must be paid to Linfield's for their pioneer work on automatic composting; they truly 'fathered' the machine, and there can be no doubt that without their backing a fully automatic composter would still be something of a pipe dream.

The Linfield Turner is designed to carry out the turning of the compost heap at all stages in the pre-

TURNER

The 'Linfield' Turner advancing into the compost heap. A view of the front of the machine.

paration of a rapid compost. It can be said that the only human intervention required is the alignment of the turner at the end of the compost heap. Thereafter it propels itself forward along the heap, feeding itself, adding water, thoroughly turning the compost, and discharging it into a neat stack, of the correct proportions, behind it. Of course in practice human attention is required, but two men are enough to ensure the correct functioning of the machine, and to carry out the very few additional tasks that the machine cannot do.

In this article we propose first to examine the machine itself, then to comment upon its ability to make a compost, and finally, to look into the performance of the turner in relation to through-put and labour.

The Linfield Turner is 24 feet long, and there are two models, one 8 feet 6 inches wide and the other 9 feet 6 inches wide. It has an overall height of 11 feet. The weight varies from 12 tons for the smaller machine to 13¼ tons for the larger. The power unit is a Perkins P4 Industrial Engine with brake horsepower of 41.5, and the drive to the wheels is through a gear box giving nine forward speeds and six reverse speeds.

The turner operates in the following manner. At the front of the machine and approximately 5 feet from the ground is a spudded roller 18 inches in diameter. As the machine moves forward into the heap the roller breaks up and pushes compost onto the elevator, which lifts from the ground level. The purpose of this roller is two-fold; it not only assists in feeding the elevator, which is itself biting into the compost, but it prevents very large masses of compost falling on to the elevator, through undermining, and being hoisted up *in toto* to jam the shredding and beating gear in the top of the machine.

The elevator lifts a steady flow of fairly evenly distributed compost, but to ensure that there are still no large masses to jam the machine, there is a second spudded roller rotating at the top. This roller evens

The general layout of the 'Linfield' Turner seen from the front. The elevator can be seen behind the front 'spudded' drum.

out the flow of compost still more, the spuds breaking up the larger lumps and distributing them across the track of the elevator.

The compost then passes beneath three spraylines, mounting high-pressure spray nozzles, and if necessary, it is subjected to water in fine mist form. These spray lines can be moved to different positions as required, and the flow of water can be regulated. The compost then passes through two rollers, a beater and a shredder, where it is thoroughly teased and aerated before being discharged at the rear of the machine.

The dimensions of the finished stack can be regulated by the position of the two steel-plate screens that trail behind the machine. As the size of the stack diminishes at each turn, the screens are set closer to each other, so restricting the width of the space into which the compost falls. The height of the stack is influenced by the rate of movement of the machine which is in turn controlled by the gears selected for the particular forward movement.

When making a true rapid compost it is necessary that the sides of the stack should be sealed by compressing the compost into a firm 'wall'. This must be carried out manually, and in practice there are usually two men attending the machine, one on each side. Their job is to fork up fragments of compost that may be pushed out by the lower roller or the bottom of the elevator, and place them back into the stack, and also to tamp the sides of the completed stack, firming it to provide the seal required.

No machine yet dreamed of can replace the human element in mushroom growing and therefore the sort of compost that the Linfield Turner will produce must be governed by the skill, experience and ability of the man in charge. The machine will do exactly what it is told to do, but it can work only within the limits of the man controlling it. He must decide on when to turn, how much water to add, at what speed to set the controls. Whether the machine produces a very good or a very bad compost is no reflection on its abilities; it can do what is required of it provided that it is given the right instructions.

With this in mind it is fair to say that the turner will make as good a rapid compost as you will find. It is probably capable of producing a much better compost than average, provided it is given the right management. It is certainly capable of reducing the time spent on composting because there is very little heat loss. When the compost is being processed in the yard, a certain optimum temperature should be pre-

sent in the stack. In order to ensure that all parts of the stack are subjected to this processing temperature, it must be turned and aerated at intervals, and inevitably during this turning operation some heat is lost. When turning by hand, the time that the stack is 'open' is sufficiently long to allow most of the heat to escape. Turning by hand-forking into a manure turner reduces this time, and also reduces the heat loss. But when the Linfield Turner is used the period during which the stack is 'open' is so short that there is relatively little heat loss.

The concept can be visualized in the form of a graph showing temperature readings against time. In the case of hand-turning, the line is horizontal with several deep, wide valleys indicating temperature drops at the time of turning. Using the fully automatic turner these valleys are perhaps only half as deep and only half as wide, so that the total processing time at the optimum temperature is arrived at in a shorter overall period of time.

The Linfield Turner must have a neat stack of compost to attack, and therefore it is necessary to shape up the heap from the time of unloading from lorries. An arrangement found to be satisfactory at the Experimental Farm consists of a number of angle iron and netting screens that can be arranged to form a corridor. The manure lorries are driven up to the side of the corridor and the dung is unloaded into it. When the screens are withdrawn the manure is shaped sufficiently to allow the turner to be aligned on it and run in for an initial wetting turn. By emptying the manure into this corridor it is possible to layer it so that the contents of one particular load are spread almost the whole length of the stack. In this way variations in quality in different loads can be evened out and the stack becomes a homogenous whole. Further, activators and supplements can be added between layers, and can be much more evenly distributed.

In rapid composting it is essential to get the water in as early as possible, and this is difficult at the best of times, doubly difficult during hot weather. By using the Linfield Turner, this operation is made very much easier because the watering turn can be carried out *twice* on the same day, a feat that would be quite impractical with a hand-fed turner.

Turning now to the economics of the machine it will be appreciated that the purchase of a Linfield Turner necessitates the provision of a suitable composting yard. On most farms composting is carried out under cover and in a relatively small area. Assuming that the minimum throughput of the farm will be 25 to

A spiked roller shreds the compost before the final discharge into the finished stack.

A rear view of the turner, showing the two full length screens which can be adjusted to regulate the final dimensions of the heap.

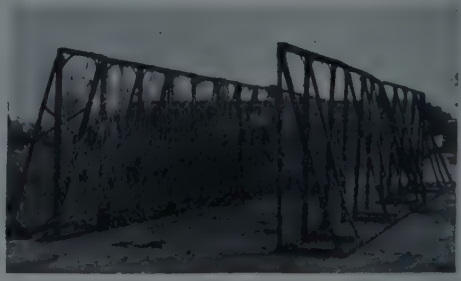
30 tons a week, giving a weekly laying area of 3,500 to 5,000 square feet and a standing area of some 50,000 square feet, the composting yard will have to be not less than 600 square yards of good concrete. For a farm with a throughput of 20,000 square feet, or standing area of some 200,000 square feet the composting yard will have to be 2,500-3,000 square yards.

It is essential that the yard should be as level as possible, with a good finish to the surface, and it is most important that it should have adequate drainage. Bearing these factors in mind, the capital investment on a composting yard for the smaller farm would be somewhere in the region of £1,500, and for the large farm about £5,000. However, it is worth considering that it would not be possible to compost on this scale in the open without using a fully automatic turner, and that the provision of a suitable roof over the yard would cost some £2,000 on the smaller farm and £9,000 on the large farm!

In estimating the running costs of the turner and comparing them with those of a hand-fed machine it must be borne in mind that the number of man-hours expended varies greatly from farm to farm. Almost every figure can be disputed by some grower, and we have therefore set down what we consider to be some sort of national average, taken from our own experience and what we know of other farms.

The capacity of a Linfield Turner is about 100 tons of compost during an 8-hour day, and during a normal working week one machine is well able to cope with the compost requirements of a farm laying 20,000 square feet a week.

Using a hand-fed manure turner of the Chatsworth type, the labour requirement probably averages $1\frac{1}{2}$ to 2 man-hours per ton per turn on the earlier turns, dropping to $\frac{1}{2}$ to $\frac{3}{4}$ man-hours per ton per turn on later turns. Averaged over the whole of a 5-turn rapid compost, the labour requirement is 1 man-hour per ton per turn. From this it can be seen



Screens in position before stacking of the manure from the incoming lorries is begun.

that on the smaller farm with a throughput of 25 to 30 tons of manure per week, the approximate labour requirement totals 135 man-hours, which would cost around £35. Putting the same initial manure through the rapid composting process with 5 turns, but using a Linfield Turner, gives a rather different picture. The average time taken to turn a 25-30 ton lump would be 3 hours and the attention of two men. Allowing 6 man-hours per turn, we get a total of 30 man-hours over the 5 turns, and a total cost for labour of £7 10s.

Now since much of the time allowed for the turning operation with the Linfield Turner is taken up in aligning the machine on the stack beforehand and servicing it afterwards it will be appreciated that the bigger the lump to be turned, the cheaper the cost. In fact, the above figures show that even on the smaller farm it is still economical to use a machine with the capacity of the Linfield Turner.

Where the throughput averages 50 tons of compost, the man-hours required over 5 turns is 40, compared with some 270 for composting by hand-fed machine. The saving per ton of compost will be in the region of 14s., although this can be greater where the farm is so organized that two or more turns are made in the course of a working day, so reducing the time between turns and time spent on end-of-day maintenance. Against this, for the smaller man using the machine, there is not the same intensive working and therefore less wear-and-tear and less depreciation, with consequent reduction in the repair and replacement bill.

It is not possible within the scope of this article to go deeply into the question of costs, but if there is any further information a grower requires, we shall be glad to assist him.

SPENT MUSHROOM COMPOST

by

H. G. Schaffer

The problem of disposing of spent mushroom compost is one that has been of concern to many growers. It is therefore good to learn that Stockbridge House have been carrying out trials with it and they recommend its use to horticulturalists.

Spent mushroom compost has given consistently good results in a long term experiment comparing various forms of bulky organic manures, at Stockbridge House Experimental Horticulture Station, Cawood, Yorks.

The experimental plots were laid down in the autumn of 1953 and five organic manures have been applied since then at rates equal to approximately 20 and 40 tons to the acre of fold yard manure. This meant that the actual amount of each was adjusted so that 3 and 6 tons per acre of ash dry matter was applied. The organics were mushroom compost, fold yard manure, straw, straw compost and sewage. A fairly heavy dressing of phosphate and potash was

given to all plots so that comparisons could be confined to organic matter and nitrogen effects. Crops grown were cauliflowers, carrots and leeks.

Other plots were given four levels of inorganic nitrogen and nitrogen added to organics.

After seven years, the general conclusion is that all the organic manures have tended to increase yield, although there have been big differences between the various materials. Spent mushroom compost has been consistently good and so has fold yard manure. Sewage generally gave poor results. Reports for the individual crops show that for cauliflowers, spent mushroom compost and fold yard manure gave the highest yields, with mushroom compost slightly ahead on average. The other three were well behind, with straw the best and sewage the least effective. Straw compost appeared to build up fertility in the early years, but its results were inconsistent.

For carrots, the spent mushroom compost and the fold yard manure were the best of the organics and gave better results than the inorganics. For leeks, spent mushroom compost and fold yard manure gave the highest yield, with very little to choose between them. Straw compost, straw and sewage gave yields in that order and all were higher than with the inorganics. The effect of the higher rate of application of the organics and of the addition of inorganic nitrogen was contradictory. In some years, yield increased and in others it was lower.

These are preliminary results and undoubtedly a great deal of additional information will be available when the results over the full seven years are analysed. Similar experiments have been carried out at other stations, but Stockbridge is the only one to include spent mushroom compost in the schedule.

Enough evidence has been secured to indicate the value of spent mushroom compost. The experiment also included periodic analyses of the various manures. These show that the mushroom compost contains more phosphate than fold yard manure and has a moisture content of about 68 compared with 83.

Stockbridge House makes one proviso in respect of spent mushroom compost. Where B.H.C. has been used to control pests in the mushroom houses root crops can be tainted if grown in soil manures with the spent compost. Where chalk is used in the casing soil, 40 tons to the acre of compost will mean including the equivalent of 2½ tons to the acre of calcium oxide. This amount could cause serious trouble if the soil already has a high lime content but it would be beneficial on acid soils. And, of course, it should never be applied to rhododendrons.

GIVE AND TAKE!

A certain modern mushroom farm recently received a government improvement grant of £1,500 towards the cost of an improved heating system. The new boiler was oil fired.

Barely had the money been banked when the Chancellor put 2d. more on oil fuel. The farm consumes 150,000 gallons of fuel oil a year. Additional annual payment to the Exchequer will be £1,250. *If* the farm does not use more oil, the value of the improvement grant now stands at £250.

The Chancellor and the Minister of Agriculture should really get together—or do they?

MUSHROOMS AND TRUFFLES. Rolf Singer, Ph.D. (Vienna). *World Crop Books Series published by Leonard Hill (Books) Ltd., 9 Eden Street, London N.W.1.*

Mushroom growers will find this book remarkably interesting for it gives a global picture of the cultivation of edible fungi. The Western world has been rather inclined to regard its own efforts in this direction as unique and it will come as a surprise to many growers to learn that Japan, for instance, cultivated over six million pounds of their own special 'mushroom', the Shiitake, in 1953 and that nearly half this amount was exported.

The book was first published in the U.S.A. some years ago, and so far as it is concerned with the cultivation of our own white mushroom, growers may find it rather dated. The technique of growing has made tremendous strides since 1954, especially in the United Kingdom, and much that was experimental seven years ago is now accepted as standard practice. Nevertheless as a sound introduction to the basic principles of growing, this book can be recommended.

It is when Dr. Singer writes of the other cultivated fungi, however, that I find him most interesting. There is the Padi Straw Mushroom, *Volvariella volvacea*, which is widely cultivated in China and especially in the Canton area. A pure culture spawn can now be obtained for this mushroom and methods are becoming ever more progressive. The beds are prepared from bundles of soaked rice straw and there is no composting process as we know it. The straw is first soaked and then stacked and spawned, and careful attention to watering will produce a crop of mushrooms. It seems very easy, and in the more remote areas they do not even bother to spawn the beds!

Most growers know already of the Japanese Shiitake, which is grown on logs cut from hardwood trees. The logs stand in rows in large yards adjacent to the forests, and they are spawned by the insertion of wood chips on which the mycelium of the Shiitake is run in pure culture. Production has been, in the past, a lengthy business but Dr. Singer gives a pointer to the future when he mentions that in the vicinity of the larger cities an industry is springing up that cultivates Shiitake in greenhouses all the year round.

Dr. Singer writes of the Perigord Truffles, and of how the special plantations of young oak trees are established. An acorn that sprouts in soil already bearing truffles carries the hyphae with it on transplantation, so that provided the climate and soil conditions are exactly those required for development of the fungus, then a new 'Truffle Farm' can be established.

The cultivation of our own particular mushroom has spread throughout the English-speaking world, with thriving mushroom industries in South Africa and Australia and the beginnings in several of the other dominions. Dr. Singer's book makes one wonder whether our mushroom is likely to find a serious competitor, especially in the far east in years to come. It may be that these other cultivated fungi will respond more prolifically to the scientific methods that are bound to come with industrialisation of the more backward countries.

A.B.

" Being a farmer he was staggered that the mushroom industry had lifted itself into the seven millions a year class entirely by its own efforts."

A.G.M. - M.G.A.

by John Brody

THE commissionaire of the Park Lane Hotel opened the taxi door and I stepped out, heading for the hotel entrance. He didn't exactly say 'Hi!' to my back; he just coughed, and it sounded as though he had.

'Mushroom grower—sir?' he asked and without waiting for an answer pointed towards a somewhat less imposing entrance.

I wondered what the distinctive sign of a mushroom grower was. Apparently I had it, even though I was travelling on someone else's ticket and I don't know a mushroom from a toadstool.

Inside the revolving door the cloakroom attendant said 'Mushroom grower?' as he took my coat. I was hailed from far off by another flunkey at the head of a flight of stairs. 'Mushrooms!' he yelled. A command, I sensed, and headed for him.

Three flights down and ankle-deep in opulence I had my first sight of a flush of mushroom growers. Well watered with gin through a fine rose, it was the neatest sample of mass pinheading Tom Figgis is ever likely to be consulted about.

Almost before my feet were off the stairs someone was buying me a drink. Later I found this was just a trick; trapped in a corner with a glass of his gin in my hand there was simply no escape until lunch was announced. Until that moment I was compelled to listen to his story about the way he was re-circulating something through something else, over somewhere and why it came back again.

We sat together at lunch, and I was glad because he seemed to know everyone, and gave me a running commentary on subsequent events. One hundred and seventy of us sat down in that gilded hall, and I was the only one who thought *La France* was *belle*.

No, I am wrong. The guest of honour joined me in my ignorance. Mr. B. G. Irvine, Member of Parliament for Rye admitted that this was his first incursion into the strange world of agariculture, and like me, he was impressed. Being a farmer he was staggered that the mushroom industry had lifted itself up into the seven millions a year class entirely by its own efforts. I, as a product of the Welfare State, was aghast to hear that there was no feather-bedding, no subsidies, no guarantees for these prosperous gentlemen. Bully for them! At least they don't have to doff caps and bow to the Establishment.

The Chairman of the Association, Mr. P. B. Stanley Evans, had already welcomed the guest of honour in one of the best after-lunch speeches I have heard for years. In fact his handling of the proceedings throughout the day was exemplary and included hazards such as unexpected questions from his wife that obviously had him rocking. He emerged from his ordeal neither bloody nor bowed.

From his speech I gathered that Chairmen of the M.G.A. invariably expect to be picked out by providence for some special, horrible fate during their year of office. I pictured a window at the Employment Exchange before which stood a line of beaten men, no longer capable of coping, who passed under the notice "Ex-Chairmen of M.G.A.—Queue Here".

And so on to their Annual General Meeting. You may well ask what I was doing there since I am not even an Associate Overseas Member. The fact is that the proceedings were so informal that it could hardly be called an A.G.M. at all. Perhaps it isn't. I did notice that no one proposed or seconded anything and there was no show of hands from 2.30 p.m. to 5.00 p.m. Presumably there is some special arrangement for passing the Minutes that bypasses these stuffy formalities that other associations insist on.

The Chairman, presenting his annual report, said that the industry continued to expand at fifteen to twenty per cent a year, yet prices have held steady over the last twelve months. I gathered that the price of mushrooms is critical; if it goes up, mushrooms will come in from the Continent, and if it goes down, growers at home will suffer. Mr. Stanley Evans mentioned those words 'planning' and 'controls'. No one breathed 'Common Market' yet they are the words that may sway the destiny of English horticulture.

When it came to 'other business' I expected fun, remembering what happens at the Tom & Cue Board outings. I was staggered—and so, I am sure, was the guest of honour—at the shortage of 'other business'. I had the impression that there was so little to talk about that half a dozen members had been tipped off to keep the ball rolling until 5 p.m. so that value for money could be had from the management of the Park Lane Hotel!

One gentleman specialised apparently in resigning. He was on his feet half a dozen times during which, if I heard him right, he announced he would resign from some research committee or other and from his seat on an editorial board. No doubt he would have to resign from something to find time for the Experimentation Station he wanted set up, presumably under his able direction.

However, the *piece-de-resistance* was reserved for the last half hour—the presentation of a pilot survey carried out by a firm of market research and advertising agents into the mushroom market. Here was drama indeed! We listened enthralled to the side-splitting reasons why some people don't like mushrooms. We listened to a grim warning. The mushroom industry *could* be saved from disaster. If instructed, the agency would carry out a full scale survey. It would cost money, lots of money. If the industry was to be saved, even more money would be required. Big money. The expert fixed us with his dark eyes and we had a sense of impending doom. Empty mushroom houses, banging doors, chill winds scurrying across deserted yards, rusting fork lifts, squatters in once busy packing sheds. Only *he* could save us!

Then, like a breath of spring air, a Mr. Thompson announced that he was cured of mass pinheading. We breathed again, and members tottered bar-wards, uncertain whether they were sitting on goldmines or volcanoes.

Some items of interest from our Postbag

Purpose-built Trays

I am thinking of going over to trays, and I have been impressed by the pictures I have seen of the trays on your farm. They look like beds, and I would be glad if you will give constructional details.

We are frequently asked for details of the type of mushroom tray in use on our farm. We are accordingly giving the specifications which may be of interest to growers turning over to the open stack method of growing.

On our Experimental Farm our trays are supplied in sets of five since this is the standard load for the Coventry Climax Fork Lift.

Construction is of Swedish whitewood or redwood, whichever is available.

Sides constructed of 1in. timber.

Ends constructed of $\frac{3}{4}$in. timber.

Bottoms constructed of $\frac{5}{8}$in. timber.

Overall measurements 46in. x 36in. x 6$\frac{5}{8}$in.

The bottom boards are nailed across the shorter distance leaving a gap $\frac{1}{2}$in. wide between the boards. One gap is left across the exact centre. This is solely a precaution so that if it ever becomes necessary the trays can be cut down to half size by sawing the original tray across and putting on new sides.

Four trays of each set are fitted with arris corners, these to project 7$\frac{1}{2}$in. above the sides of the tray. The arris corners are made by sawing down diagonally suitable lengths of timber 3in. x 3in. square. It should be noted that the top tray of the set *has no arris corners*

All nails to be 2$\frac{1}{2}$in. galvanised except where $\frac{3}{4}$in. timber is nailed, when they are 2in. galvanised.

Cropping area of each tray 10.4 sq.ft.

Overall height of 5 trays 5ft. 3$\frac{1}{8}$in.

Heavier Spawning

I have noticed that since I have been using twice as much grain spawn and mixing it through the compost, the temperature in the house has risen sharply during spawn run. Is this normal?

A sharp rise in the temperature of the compost some days after spawning is normal occurance and is due to the growth and respiration of the mushroom mycelium. Even where moist manure spawn was used in the shelf system of growing it was noticeable that, some 10-14 days after spawning, the bed temperature registered 10°F. above the original spawning temperature.

With the introduction of grain spawn and the tray system and a faster spawn run this temperature rise in the compost occurs much earlier and is more pronounced. If the spawning rate is doubled, and particularly if 'through spawning' is practised, the grower should keep a close check on the compost temperature in the trays. Any tendency to a temperature rise should be counteracted by reducing the house temperature and introducing increased air.

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First of all, fermentation goes ahead at a faster rate. Composting takes less time and the finished product is ready earlier.

Secondly, you have greater assurance that your crop will be free of pests and disease. The higher temperature either kills off the pests inside the heap or drives them to the surface, where they can be dealt with by insecticides. High temperatures during fermentation are particularly vital in preventing disease such as Vert-de-gris, of which there is special danger when composting during the winter months.

More nourishment

If you use Racing Stable manure, or other manure in which excess straw is present, the use of Adco "M" is strongly advised. The fermentation of this type of manure takes place more rapidly and effectively when Adco "M" is added. You get a more thorough breakdown of the strawy material, which then becomes available as food for the growing spawn. So your compost provides more nourishment for the mushrooms, and you get a bigger crop.

Better spawn run

Adco "M" produces a good quality compost of even texture. It provides an ideal medium for spawn run and helps to avoid greasy conditions, lack of aeration, and over wet compost – all of which delay mycelium growth. The spawn is able to make more rapid use of the food provided. It establishes itself more quickly and this is again a great help in preventing diseases and weed fungi. The faster the spawn grows and fills the compost the less likelihood is there of disease and weed fungi becoming serious competitors. A quick spawn growth also gives a quicker ultimate production.

You can have freedom from uncertainty in the composting process – by using Adco "M". It will pay you hands down. Adco "M" is specially formulated as a result of years of experiment, for the specific purpose of making mushroom compost. It can be used for composting with straw alone, if you wish. Or it can be used to compensate for variations in the quality and texture of your manure supply. Adco "M" provides the way to better mushroom compost every time.

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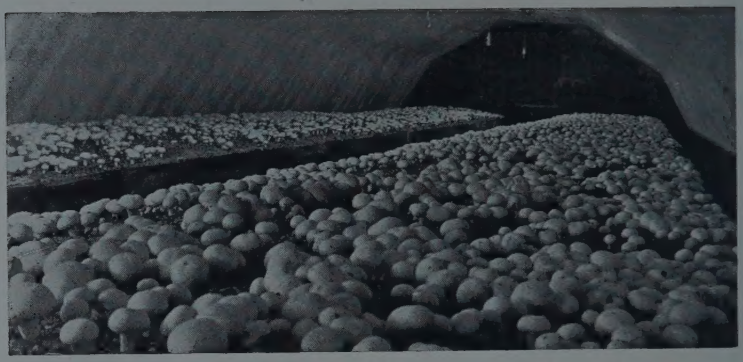

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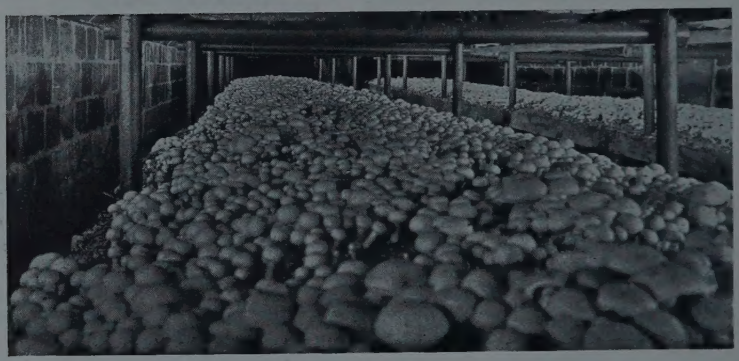

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